Forecasting the Yield Curve: An Econometric Study

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YC and data

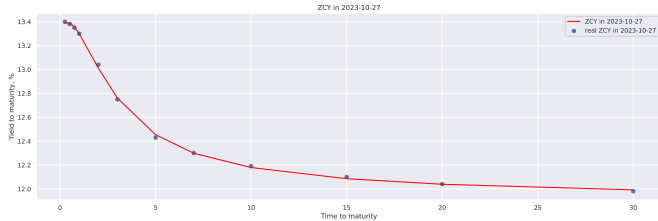


Figure: Yield Curve

$$G(T) = \beta_0 + (\beta_1 + \beta_2)\frac{\tau}{T}\left(1 - e^{-\frac{T}{\tau}}\right) - \beta_2 e^{-\frac{T}{\tau}}, \tag{1}$$

where T is the time to maturity, $G(T)$ is the yield estimator, and the parameters to be estimated are: β_0 is the long-run of zero-bond yields, β_1 is the mid-run of zero-bond yields, β_2 is the short-run of zero-bond yields.

Structural breaks in factor dynamics

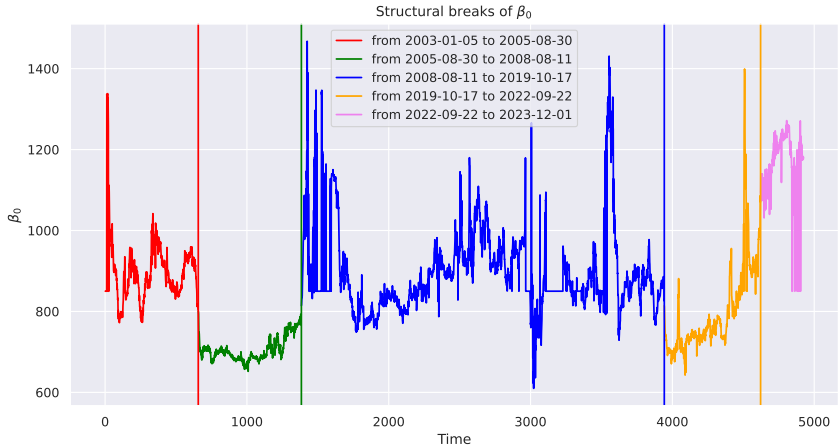


Figure: Yield Curve

Structural breaks in factor dynamics

1. 2005: The complete stabilization of the Russian economy, the war in Iraq.
2. 2008: the Russo-Georgian Conflict and the beginning of the world finanical crisis.
3. 2018: protests from March 2017 to the end of 2018. Also, there was a 2018 FIFA World Cup.
4. 2020: COVID-19 pandemic.
5. 2022: special military operation.

Factors forcasting

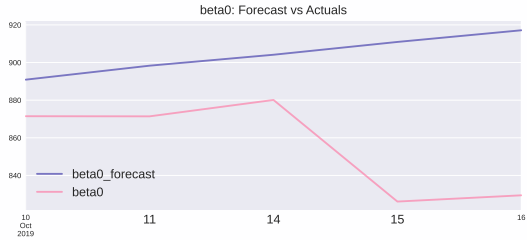
Factor	MAPE	MAE	RMSE
β_0	0.006	5.5102	6.0729
β_1	0.3471	29.3697	32.2907
β_2	0.5223	93.8611	95.6724
τ	0.9588	1.8988	1.987

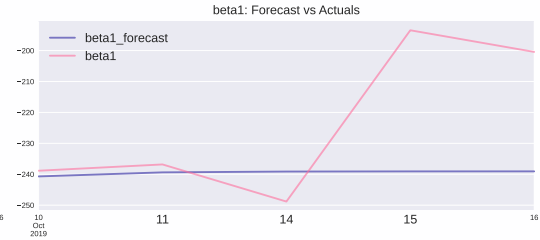
Table: NS factors forecasting results using ARIMA for the last segment.

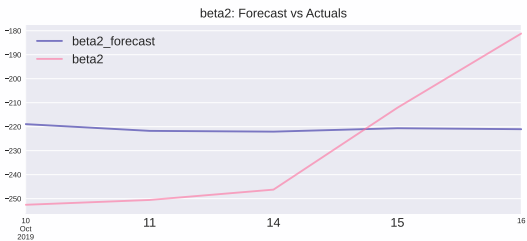
Factor	MAPE	MAE	RMSE
β_0	0.0139	12.8457	14.9255
β_1	0.134	12.1766	15.9566
β_2	0.3394	60.4861	61.5831
τ	0.3582	0.68	0.7972

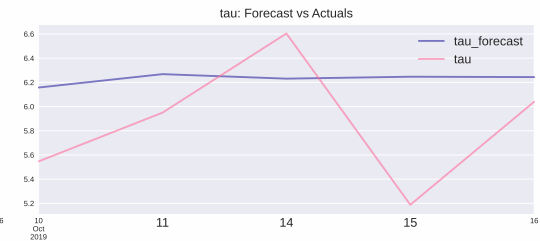
Table: NS factors forecasting results using VAR for the last segment.

Nelson-Siegel factors forcast using ARIMA

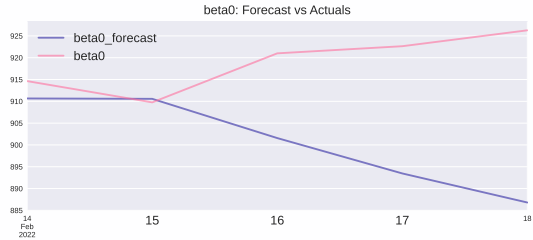


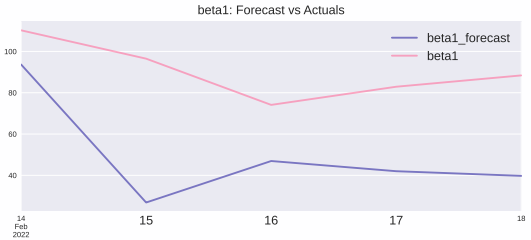


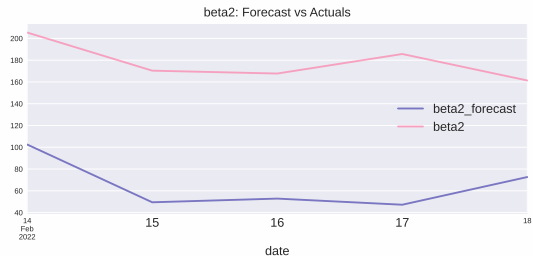


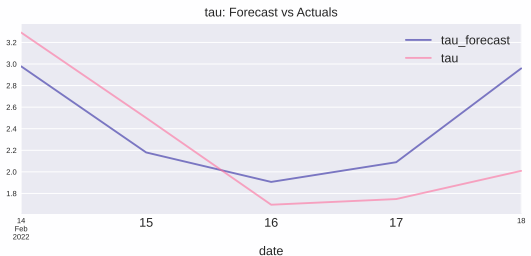


Nelson-Siegel factors forcast using VAR









Nelson-Siegel factors forcast using MS-ARIMA

TTM	MAPE−MS	MAPE	MAE−MS	MAE	RMSE−MS	RMSE
0.25	0.034	0.0354	0.3575	0.3716	0.4118	0.4187
0.5	0.0312	0.033	0.3298	0.3482	0.3978	0.4082
0.75	0.0311	0.0328	0.3283	0.3461	0.38	0.3912
1.0	0.0312	0.0335	0.3282	0.3517	0.3643	0.3785
2.0	0.0378	0.0394	0.3896	0.4061	0.3924	0.4105
3.0	0.0425	0.0449	0.4347	0.459	0.4425	0.4721
5.0	0.0471	0.0512	0.4746	0.5142	0.49	0.541
7.0	0.0467	0.0492	0.4641	0.4879	0.4766	0.5111
10.0	0.0419	0.0435	0.4115	0.4274	0.4154	0.4315
15.0	0.0338	0.0349	0.3281	0.3387	0.3337	0.343
20.0	0.0272	0.0308	0.2627	0.2967	0.2815	0.3037
30.0	0.0207	0.0237	0.2	0.2279	0.2481	0.2595

Table: ARIMAX-MS vs ARIMA.

Nelson-Siegel factors forcast using ARIMA

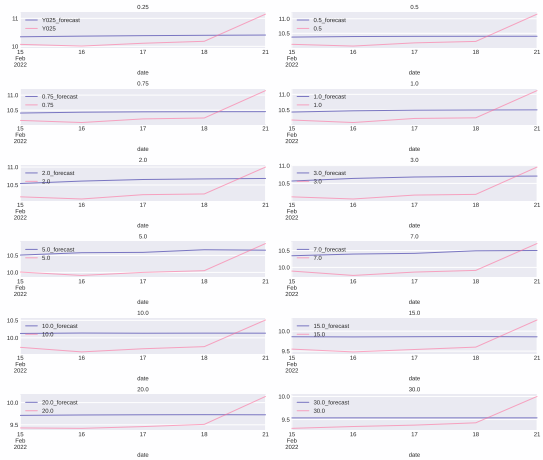


Figure: ARIMA forcast

Nelson-Siegel factors forcast using ARIMAX-MS

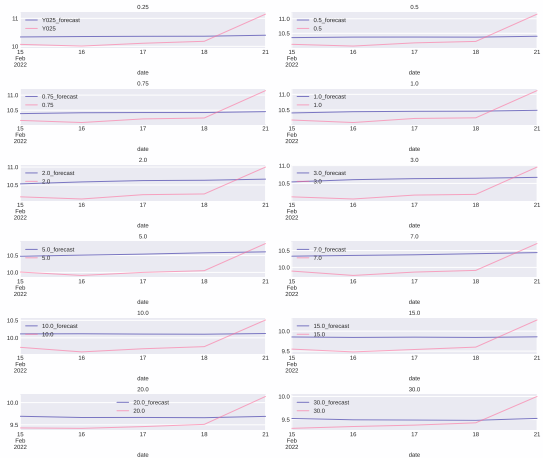


Figure: ARIMAX-MS forcast